

part, "a new method of forming a chip scale package (CSP) where the I/O ball connections are directly reflowed to the chip pads through vias formed in an intervening next level of substrate."

Similarly, the first line on page 11 has been corrected to state, in part, "substrate (150), preferably a bismaleimide triazine (BT), having a thickness between about 150 to 300 micrometers (μm) is adhered to an adhesive layer (160), . . ."

Also, as the examiner suggests, on page 14, line 9, applicant does mean "encapsulated (390)".

In the claims, claim 1 has been amended so as to avoid a process claim language that, it is believed, includes a manipulative step (providing) so as to make the claim conform to device claim language. Likewise, claim 3 has been amended to refer back to the device of claim 1.

It is believed that the examiner's objections have now been overcome, and it is so requested, respectfully.

Reconsideration of the rejection of claims 1, 5 and 9 under 35 USC 103(a) as being unpatentable over US Patent Application Publication No. US 2001/0021541, Application No. 09/832,160 (Akram, et al.,) is respectfully requested in view of the amended claims and for the reasons hereinafter given.

Applicant is in agreement with the examiner that Akram, et al., disclose a chip-scale package (CSP). However, the chip of the instant invention is adhered on to a substrate with an adhesive. The substrate comprises bismaleimide triazine having a thickness between about 150 to 300 μm , and the adhesive layer is very thin, between about 10 to 100 μm , and hence different from that of the reference. These limitations of claim 6 have been incorporated into claim 1, and accordingly, claim 6 cancelled. It is believed that independent claim 1, and hence, claims 5 and 9 dependent from claim 1 are now allowable, and it is so requested, respectfully.

Reconsideration of the rejection of claims 2 and 3 under 35 USC 103(a) as being unpatentable over US Patent Application Publication No. US 2001/0021541, Application No. 09/832,160 (Akram, et al.,) in view of US Patent No. 5,846,875 (Haji), is respectfully requested in view of the amended claims and for the reasons hereinafter given.

It is believed that claim 1 is now allowable in view of the amendment to the claim and for the reasons given above. Hence, it is believed that claims 2 and 3 dependent from claim 1 are also allowable, and it is so requested, respectfully.

Reconsideration of the rejection of claims 4 and 6 under 35 USC 103(a) as being unpatentable over US Patent Application Publication No. US 2001/0021541, Application No. 09/832,160 (Akram, et al.,) in view of US Patent No. 6,265,782 (Yamamoto, et al.,), is respectfully requested in view of the amended claims and for the reasons hereinafter given.

Claim 6 has been incorporated into claim 1, and accordingly, cancelled. It is believed that claim 1 is now allowable in view of the amendment to the claim and for the reasons given above. Hence, it is believed that claim 4 dependent from claim 1 is also allowable, and it is so requested, respectfully.

Reconsideration of the rejection of claims 7 and 8 under 35 USC 103(a) as being unpatentable over US Patent Application Publication No. US 2001/0021541, Application No. 09/832,160 (Akram, et al.,) in view of US Patent No. 5,480,835 (Carney, et al.,), is respectfully requested in view of the amended claims and for the reasons hereinafter given.

It is believed that claim 1 is now allowable in view of the amendment to the claim and for the reasons given above.

Hence, it is believed that claims 7 and 8 dependent from claim 1 are also allowable, and it is so requested, respectfully.

Reconsideration of the rejection of claims 10-16, 18, 19, 22-27 and 31 under 35 USC 103(a) as being unpatentable over US Patent Application Publication No. US 2001/0021541, Application No. 09/832,160 (Akram, et al.,) in view of US Patent No. 6,355,507 (Fanworth), is respectfully requested in view of the amended claims and for the reasons hereinafter given.

It is believed that claim 1 is now allowable in view of the amendment to the claim and for the reasons given above. Hence, it is believed that claim 10 dependent from claim 1 is also allowable, and it is so requested, respectfully.

Claim 11 has been amended to incorporate the limitations of claims 16 and 18, and accordingly, claims 16 and 18 have been cancelled. For the reasons given above for claim 1, it is believed that claim 11 is now allowable, and hence, also claims dependent from claim 11. It is respectfully requested that the remaining claims 12-15, 19, 22-25 dependent from claim 11 also be allowed.

Furthermore, it is not clear from the examiner's statements at the bottom of page 11 as to how claims 18, 22, 24, 25 and 27 deemed to have been considered.

As for claim 26, the method of the "adwafer" of the instant invention is different from the cited references in view of the fact that an adhesive layer is first formed over the wafer (claim 26, line 9). The wafer is then sawed, followed by attaching the die to the substrate, thus forming the chip scale package. It is believed that this is different from the cited references, including Fanworth. That the wafer is first formed to comprise "adwafer" thusly, is further emphasized by the inclusion of the thickness of the adhesive layer on the wafer. In view of this amendment, and for the reasons given, it is believed that independent claim 26 is now allowable, and hence, claims 27-32 and 34-41 dependent from claim 26, and it is so requested, respectfully.

Reconsideration of the rejection of claims 17 and 21 under 35 USC 103(a) as being unpatentable over US Patent Application Publication No. US 2001/0021541, Application No. 09/832,160 (Akram, et al.,) in view of US Patent No. 6,355,507 (Fanworth) further in view of US Patent No. 6,265,782

(Yamamoto, et al.), is respectfully requested in view of the amended claims and for the reasons hereinafter given.

It is believed that claim 11 is now allowable in view of the amendment to the claim and for the reasons given above. Hence, it is believed that claims 17 and 21 dependent from claim 11 are also allowable, and it is so requested, respectfully.

Reconsideration of the rejection of claim 20 under 35 USC 103(a) as being unpatentable over US Patent Application Publication No. US 2001/0021541, Application No. 09/832,160 (Akram, et al.), in view of US Patent No. 6,355,507 (Fanworth) further in view of US Patent No. 6,232,247 (Matsuki, et al.), is respectfully requested in view of the amended claims and for the reasons hereinafter given.

It is believed that claim 11 is now allowable in view of the amendment to the claim and for the reasons given above. Hence, it is believed that claim 20 dependent from claim 11 is also allowable, and it is so requested, respectfully.

Reconsideration of the rejection of claims 28-30 and 32-41 is respectfully requested in view of the amended claims and for the reasons hereinafter given.

It is respectfully suggested that the combination of these various references cannot be combined without reference to applicant's own invention. Applicants have claimed their processes in detail. The processes of Figs. 2a-2j, 3a-3f and 4 (Claims 1-5, 7-15, 17, 19-32 and 34-41) are believed to be novel and patentable over these various references, because there is not sufficient basis for concluding that the combination of claimed elements would have been obvious to one skilled in the art. None of the references contemplate the use of a very thin substrate attached to a chip or a wafer by means of a very thin adhesive for making chip scale packages. That is to say, there must be something in the prior art or line of reasoning to suggest that the combination of these various references is desirable. It is believed that independent claims 1 and 11 and 26, and hence claims 2-5 and 7-10 dependent from claim 1, claims 12-15, 17, 19-25 dependent from claim 11, claims 27-32 and 34-41, as amended, are allowable, and we therefore request respectfully that examiner Patricia M. Costanzo reconsider this rejection in view of these arguments and the amendments.

Allowance of all claims, as amended, is requested.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attachment is captioned **"Version with Marking to Show Changes Made."**

Applicant has reviewed the prior art made of record and not relied upon, and it is agreed with the examiner that while these references are generally within the field that none of them suggest the applicants' detailed claimed invention.

It is requested that should the Examiner not find that the Claims Allowable that are now presented, that he call the undersigned Attorney at 845/452-5863 to overcome any problems preventing allowance.

Respectfully submitted,



Stephen B. Ackerman, Reg. No: 37,761

VERSION WITH MARKINGS TO SHOW CHANGES MADE

3

IN THE SPECIFICATION

- 6 Second paragraph on page 10 has been amended as follows:

It is also known in the art that chip sites are first formed on a semiconductor substrate to form a wafer, where the substrate is provided with pads (110/115) or (140/115) that are connected to underlying multi-level metal layers through intervening insulating dielectric layers, and ultimately to integrated circuit devices that have already been conventionally formed within and on the substrate. These conventional steps are well known in the art and as they are not significant to the invention, they are not described in detail here in order not to unnecessarily obscure the present invention. However, it is described below in the embodiments of the present invention a new method of forming a chip scale package (CSP) where the I/O ball connections are directly [mounted on] reflowed to the chip pads through vias formed in an intervening next level of substrate.

First paragraph on page 11 has been amended as follows:

Thus, as a key aspect of the present invention, substrate (150), preferably a bismaleimide triazine (BT), having a thickness between about 150 to 300 micrometers (μm) is [mounted with] adhered to an adhesive layer (160), having a thickness between about 10 to 100 μm . Layer (160) can be a polyimide thermocompression adhesive SPA made by Nippon Steel Chemical. The adhesive and the substrate together form an "adsubstrate" composite structure, reference numeral (165), as shown in Fig. 2c. The composite adsubstrate is then either mechanically drilled, or, preferably laser drilled with an area array of via openings (170) that correspond to AA I/O pads (110) or (140) on the chip, as shown in Fig. 2d. A top view of the adsubstrate with AA openings is also shown in Fig. 2e.

First paragraph on page 14 has been amended as follows:

embodiment, is next prepared with drilled via openings (380) corresponding to the AA pad array on the CSPs to be attached as shown in Fig. 3c. It is preferred that substrate (370) comprises BT and has a thickness

between about 150 to 300 μm . Then the CSP of Fig. 3b is die attached to substrate (370), as shown in Fig. 3d. This is accomplished at a pressure between about 1.5 to 2.5 Mpascales and temperature between about 250 to 350 °C. The resulting package is next encapsulated ([300] 390) using a molding process as shown in Fig. 3e. This is followed by another key feature of the second embodiment, namely, a reflow ball mounting (400) process over openings (360) that connect to the AA I/O pads of the chip sites within the wafer, as shown in Fig. 3f. This is accomplished by forming solder comprising tin-lead or tin-silver alloy.

IN THE CLAIMS

9. Claims 1, 3, 11, 26 have been amended as follows, and claims 6, 16, 18 and 33 cancelled:

1. A Chip Scale Package (CSP) comprising:

3 [providing] a silicon chip having I/O pads;

an under-ball metallurgy (UBM) layer on the surface of

6 said I/O pads;

a substrate having a thickness between about 150 to 300 μ m
9 [with] adhered to an adhesive having a thickness between
about 10 to 100 μ m to form an [()adsubstrate()], [and] the
adsubstrate having openings corresponding to the locations
12 of said I/O pads; and

ball mountings formed over said adsubstrate and reaching
15 said UBM layer over said I/O pads on said chip.

3. The [method] CSP of claim 1, wherein said UBM layer
comprises nickel or copper.

3

Claim 6 has been cancelled.

11. A method of forming a chip scale package (CSP)
comprising the steps of:

3

providing one or more chips having I/O pads with UBM layer
on the surface of said I/O pads;

6

providing a substrate having a thickness between about 150
to 300 μm ;

9

applying an adhesive layer with a thickness between about
10 to 100 μm over said substrate, thus forming an

12

adsubstrate composite;

15

forming openings in said adsubstrate composite to match the
spacing of corresponding said I/O pads of said chip;

18

attaching said chip(s) on said adsubstrate composite
wherein said I/O pads of said chip(s) are placed on the
corresponding openings on said adsubstrate composite to
form a package;

21

forming a molding material around said package;

24

performing ball mounting over said openings on said
adsubstrate of said package; and

27

[forming] sawing said substrate to form said CSP.

Claims 16 and 18 have been cancelled.

26. A method of forming a chip scale package (CSP) comprising the steps of:

3

providing a wafer having a plurality of chip sites with I/O pads;

6

forming an under-ball metal (UBM) layer over said I/O pads;

9

forming an adhesive layer over said UBM layer on said wafer to form an adwafer, the adhesive layer having a thickness between about 10 to 100 μm ;

12

forming openings in said adhesive layer on said adwafer to reach said I/O pads underlying said UBM layer;

15

die sawing said adwafer to form said chip scale package (CSP);

18

providing a substrate having openings corresponding to said I/O pads;

21

MEG2000-012

attaching said CSP with said adhesive to said substrate;
and

24

forming ball mountings on said openings on said substrate
to attach to said I/O pads on said CSP.

27

Claim 33 has been cancelled.